Before the
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, DC 20554

In the Matter of	)	
	)	
Preserving the Open Internet	)	GN Docket No. 09-191
	)	
Broadband Industry Practices	)	WC Docket No. 07-52

COMMENTS OF THE DISTRIBUTED COMPUTING INDUSTRY ASSOCIATION (DCIA)

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Introduction

The Distributed Computing Industry Association (www.DCIA.info) is a non-profit trade organization focused on commercial development of peer-to-peer (P2P) technologies and related distributed computing applications.

More than 130 companies are currently Members of the DCIA, representing P2P, cloud computing, and social networking software developers and distributors, content rights holders, Internet service providers (ISPs) and service-and-support companies. DCIA Membership is organized accordingly into three groups: operations (software developers and distributors), content (creators and rights holders), and platform (broadband network operators and service-and-support firms).

The DCIA conducts working groups and special projects, such as the Consumer Disclosures Working Group (CDWG), Inadvertent Sharing Protection Working Group (ISPG), P2P Digital Watermark Working Group (PDWG), P2P-for-Games Working Group (PFGWG), P2P PATROL, P2P Revenue Engine (P2PRE), and the P4P Working Group (P4PWG).

The P4PWG, which was established in July 2007, is relevant to this proceeding and will be described below.

The DCIA also conducts 4-to-6 trade conferences annually, typically in conjunction with larger related conventions and expositions, and publishes the weekly online newsletter DCINFO.

DCIA Member companies are engaged in developing and deploying competitive commercial services that use P2P and related technologies, including cloud computing, downloadable file sharing, live P2P streaming, swarming, caching, torrenting, content acceleration, peer-to-peer television (P2PTV), and hybrid P2P content delivery network (CDN) offerings, among others.

DCIA Member companies are also engaged in creating, aggregating, and delivering content, representing music, video, games, and software categories.

And finally, DCIA Member companies are engaged in providing and supporting Internet access services, including the most rapidly expanding and highest value area within the telecommunications sector, broadband or high-speed offerings.

DCIA Member companies and other competitive distributed computing applications and services represent the technologically most advanced and fastest growing segment for delivery of digital content over the Internet.

The DCIA strongly supports the Federal Communications Commission's (FCC's) principles that emphasize the importance of an open Internet as a vehicle for empowering consumers, putting users at the forefront of deliberations as to whether broadband networks are operating appropriately, without discriminating against institutional users of network resources; and whether such applications and services, as well as content providers themselves are operating appropriately, without abusing these network resources.

Our concern is that the uncertainty associated with the Commission's current rulemaking process has caused US-based industry participants to curtail their participation in the P4PWG, an important and effective process, which had been addressing key areas of broadband network resource utilization and related P2P software functionality, and to reduce their involvement to a wait-and-see status until this can be clarified.

P4P has been successfully field-tested by AT&T, Comcast, and Verizon Communications, for example, working with Pando Networks and Yale University; and key results of these trials have been published.

As is clearly illustrated by the contrast in the 2007-through-2008 versus the 2009 track record of accomplishments of the P4PWG, which was very active with US-based field trials, sub-group expansion, standards-setting, and related activities demonstrating substantial progress during the former period, these efforts have essentially moved offshore during the latter period.

The DCIA gladly offers the trade association's resources to support fact-finding activities, such as public hearings and related undertakings, to ensure that the FCC gathers sufficient relevant data to be able to act in the best interests of all constituents on this issue. We also request the Commission's support and encouragement of collaborative intra-industry private sector efforts as exemplified, although not exclusively represented, by the P4PWG.

It should be noted that the views expressed in this document reflect those of the DCIA as a whole. Individual DCIA Member companies' views may differ.

Executive Summary

While open peer-to-peer (P2P) software is unfortunately often associated with unauthorized file sharing of copyrighted material, today it is increasingly used by a growing number of licensed content distributors. Major content library and catalog copyright holders have begun to embrace the utility of P2P technology for distributing large audio and video and software files efficiently, rapidly, and securely.

P2P applications, working independently or in concert with other content delivery solutions, enable rights holders – ranging from leading games publishers to major motion picture studios and music labels to independent professional producers of a wide variety audio and video works to consumer publishers of user-generated content (UGC) – to distribute their material to a global audience in a simple and cost-effective fashion.

Business models associated with commercial P2P applications further enable rights holders to monetize their content through methods ranging from paid-download to subscription to advertising-supported. Content owners of virtually all sizes can offer their works to viewers for free, at no charge with advertising support, packaged in a variety of ways for one-time-only or recurring subscriptions, or a la carte as stand-alone items for consumption at whatever prices they choose.

P2P technologies can bring greater scalability to what has previously been, by Internet standards, a relatively inefficient market for the distribution and monetization of entertainment and information content.

With an ever-expanding variety of content and flexible options for monetizing its distribution, P2P-based offerings have the potential to help deliver on one of the most attractive promises of the Internet, in which users can access virtually any content available as well as produce and distribute their own content to the world.

The steady growth in digital distribution of rich media by a rapidly expanding field of competitors, particularly those using various forms of distributed computing technologies, however, is also creating new challenges and higher stakes.

The Federal Communications Commission (FCC), therefore, has an important role to play in ensuring that the Internet continues to develop to its fullest potential as an open, competitive environment for innovative services that will benefit consumers.

Peak usage of current generation high-bandwidth-using P2P and hybrid-P2P applications and services challenges carriers by driving the need for significant capital investments. In some cases, P2P applications can degrade the network performance of other consumer applications, which increases the carrier's customer care costs.

The increasing use of such applications and services to transmit high-value rich media content, supported by paid-download, subscription, and advertising-supported business models, raises the stakes for all involved in these new distribution systems. Projections range from the tens to the hundreds of billions of dollars of commerce annually for US-based companies operating in this space during the next five years.

The combination of these factors, and their potential impact on other important uses of the Internet for communications, research, and other vital business and personal purposes, which include advancing First Amendment values as well as serving as an engine for economic activity, further warrants the Commission's attention to these important issues.

The P4P Working Group (P4PWG) was established in July 2007 at the recommendation of DCIA Member companies Verizon Communications and Pando Networks, industry leading firms representing Internet service providers (ISPs) and P2P software distributors respectively, after separately reviewing advanced research taking place at leading American academic institutions, led by Yale University.

The intention of establishing the P4PWG was to formulate an approach to P2P network traffic management as a joint optimization problem. The objective of certain participating ISPs, for example, was to minimize network resource utilization by P2P services. The objective of certain participating P2P software firms, conversely, was to maximize throughput. The joint objective of both ISPs and P2P software developers was to protect and improve their customers' experience.

P4P was defined as a set of business practices and integrated network topology awareness models designed to optimize ISP network resources and enable P2P-based content payload acceleration.

The mission of the P4PWG was codified as, "To work jointly and cooperatively with leading ISPs, P2P software distributors, and technology researchers to ascertain appropriate and voluntary best practices for the use of 'P4P' mechanisms to accelerate distribution of content and optimize utilization of ISP network resources in order to provide the best possible performance to end-user customers."

Objectives of the P4PWG include providing ISPs with the ability to optimize utilization of network resources while enhancing service levels for P2P traffic; providing P2P software distributors with the ability to accelerate content delivery while enhancing efficient usage of ISP bandwidth; providing researchers developing P4P mechanisms with the support to advance and the ability to publish their work; determining, validating, and encouraging the adoption of methods for ISPs and P2P software distributors to work together to enable and support consumer service improvements as P2P adoption and resultant traffic evolves while protecting the intellectual property (IP) of participating entities; and establishing appropriate and voluntary best practices for the deployment of P4P mechanisms to meet the above identified objectives in a way that can be sustained by all of the necessary participants.

Participants in the P4PWG include ISPs, P2P software distributors, technology researchers, DCIA Member companies, and information technology (IT) firms involved in digital media platforms.

Participants share the view that the Internet is the media delivery platform of the future; new technologies are needed to scale the Internet for higher quality and greater capacity media delivery; and P2P networks represent a disruptive and attractive market opportunity.

From 2000 through 2006, P2P was often considered a rogue technology, more associated with copyright infringement than with highly efficient, secure commercial distribution of digital content. Typical activity in this space tended to be relegated to the operation of standalone open file-sharing networks by their respective software developers and distributors.

2007 marked a turning point for the emerging P2P industry, with P2P beginning to become part of the content delivery infrastructure in large scale deployments, and content owners increasingly indicating a preference for integrated P2P and content delivery network (CDN) solutions. Major content and CDN players started to select P2P technology partners to enhance their service offerings.

Meanwhile, Internet traffic between the years of 2000 and 2007 saw P2P grow from virtually non-existent to representing as much as 50-65% of downstream traffic and 70-80% of upstream traffic in many locales.

Steadily increasing consumer adoption of P2P services, along with the practice of random peering, has caused traffic to spread across points-of-presence (POPs) and domains requiring greater than necessary network resource usage (e.g., using bandwidth of more links) resulting in higher than needed network operational costs, and at times degraded performance of other applications.

ISPs have addressed the growing predominance of P2P traffic not only by upgrading their network infrastructures and deploying P2P caching devices and content acceleration solutions, which are constructive performance-enhancing approaches to this trend in consumer adoption; but also in some cases by terminating P2P user connectivity, rate-limiting P2P traffic, and similar practices that have led some parties to raise concerns about the propriety of those techniques.

P2P companies with sufficient resources have retaliated by using random ports, encrypting their traffic, and implementing similar work-arounds to protect their quality of service (QoS).

A fundamental problem has been that traditional ISP feedback/controls for application traffic, such as routing and rate-control through congestion-feedback mechanisms (e.g., packet drops) are ineffective for P2P.

Due to the highly dynamic, scattered traffic pattern caused by dynamic, unguided peer selection characteristics of many P2P networks, a more advanced mechanism is needed for ISPs to communicate with P2P applications about their network structures and policies.

At its highest level, the P4PWG represents the opportunity for partnerships among ISPs and P2P networks to address this. There are currently more than 50 active participating companies in the P4PWG representing ISPs, P2P software distributors, researchers, and service-and-support companies. In addition, there are now approximately 50 observers, representing vendors, cable multiple system operators (MSOs), content providers, and other interested parties.

The P4PWG seeks to create a framework to enable better ISP and P2P coordination. Guided P2P connections will yield benefits to all affected parties, including an improvement of throughput to P2P users, enablement of ISPs to manage link utilization, reduction of the number of links transited by content, and a transitioning of traffic from undesirable (expensive/limited capacity) links to more desirable (inexpensive/available capacity) links.

Benefits to commercial interests will include an industry-wide solution based on open standards and best practices that will be characterized by cooperative win-win attributes.

P4P can provide the way to solve a pending bandwidth crisis before it becomes a serious threat and provide a means to collaboratively and cooperatively address future capacity concerns. There is the potential to have carrier-grade P2P with P4P, which in turn can open opportunities for innovative new services, once it has been established that the fastest path from point A to point B on a network is via P4P-enhanced P2P.

Benefits to consumers will include faster downloads, higher QoS, and potential assurances of not being subject to service interruptions or degradation.

In short, P4P can enable content delivery that is more efficient for both the consumer and the network operator compared to alternative architectures.

With traditional client-server CDNs, each recipient's networked device requires an individual session with the server hosting a given content file as its originating source for all distribution. More users result in worse performance and higher costs.

Decentralized P2P alleviates this, but is blind to different network resource impacts at the Internet transit, regional router, and edge network levels.

Network-aware P2P, enhanced with P4P, has the potential to reduce the network transport costs at each level of the network, while also optimizing the traffic flow so that users receive better performance. If P4P achieves these benefits, it can bring about a “win-win” situation for carriers, consumers, software companies, and content providers.

The framework for P4P as it is being developed by the P4PWG is intended to support performance improvements for both ISPs and P2P companies.

Scalability is emphasized along with flexibility to support a large number of P2P users, many P2P architectures (including tracker-based and trackerless systems), and multiple networks in dynamic settings. Consumer privacy is protected as a fundamental condition of P4P. P4P is in the process of being formalized as an open standard that can be utilized by any P2P firm and any ISP.

The following data is exchanged in P4P: Participating P2P companies implement pTracker software enhancements that communicate with ISP-controlled iTrackers. ISPs provide network maps to their iTrackers; the iTrackers provide a "weight matrix" to P2P applications (without revealing proprietary ISP topology information). Information flow occurs with the peer querying the pTracker, the pTracker asking the iTracker for guidance, the iTracker returning high-level peering recommendations, and the pTracker selecting and returning a set of active peers, according to these suggestions. iTrackers can be run by trusted third parties, P2P networks, or ISPs.

The aim of P4P is a reduction in data delivery average "hop count," which will equate to lower costs to ISPs. P4P will also yield a dramatic improvement in data delivery speed, which will result in faster downloads for users and improved QoS for P2P services.

The P4PWG is free to join, open, and inclusive. It operates with a public website to communicate information industry-wide, a participant-only wiki to facilitate collaborative project management work, monthly meetings / conference calls, and e-mail list participation. After several sets of simulation studies conducted during 2007 demonstrated very significant potential, a number of field tests, led by a number of US-based companies, were conducted during 2008 yielding continued positive results. This work continued on a reduced scale, primarily overseas, through 2009.

Currently, however, outside of the work of the P4PWG, there exists a situation where some (but not all) US and international ISPs reportedly engage in bandwidth-shaping and related traffic-interrupting techniques resulting in degradation of service levels for certain applications and services providers, including P2Ps, which may impair their commercial viability or drive them to engage in retaliatory counter-measures to work around such practices.

On the one hand, this raises the question of whether broadband network operators should be permitted to restrict or block traffic carried on their networks. On the other hand, this also raises the question of what responsibilities application and service providers should have in terms of the amount of bandwidth and other network resources their innovative offerings consume, and the impact that such consumption has for an ISP's aggregate customer base, particularly in the distribution of increasingly large files, which is the case with high-definition (HD) full-length motion pictures and television program series, certain videogames, large music collections, and other rich media properties.

The core question underlying both of these issues is what constitutes "reasonable network management?"

The DCIA is concerned about allegations that the distribution of rich media content by independent third parties can be unfairly impeded by some network operators who would prefer to restrict their Internet subscribers to content in which the network operator has a financial interest. The alleged degradation and blocking of content delivered by certain distribution technologies also calls into question whether consumers are effectively able to access the content of their choice, run applications and use services of their choice, and benefit fully from competition among network providers, applications and services providers, and content rights holders – in a manner consistent with the Commission's broadband principles. Indeed, some parties have argued that by degrading the high-quality content or slowing the speed of delivery, or in other ways reducing the QoS by which such competitors differentiate themselves in the marketplace, network operators could unfairly create a competitive edge.

The DCIA believes that, as a general matter, ISPs need the ability to reasonably manage their networks, but such network management practices should take into account the actual impact that Internet traffic has on the network and should be utilized equitably on Internet traffic, while recognizing that different applications can impact the network differently. Likewise, application, content, and service provider practices should be based on their actual requirements for use of bandwidth and other network resources and they should not consume bandwidth and other network resources inequitably.

The DCIA also believes that ISPs should explain to their customers, in plain language, how the ISP's network management practices may materially impact the customers' Internet experience. At the same time, however, ISPs should not be required to disclose network management practices that are competitively sensitive or proprietary, nor should they be required to disclose information that would undermine their ability to keep their networks and customers secure.

The DCIA further believes that the best way to accomplish these goals is for all of the relevant stakeholders to work collaboratively toward mutually beneficial solutions. To that end, we recommend that the Commission encourage network operators, Internet companies, content rights holders, consumer groups, and other interested parties to discuss a variety of reasonable network management practices using private sector forums such as the P4PWG as well as public platforms.

The DCIA encourages the Commission to ensure that its examinations of ISP network management practices and its related rulemaking be properly grounded on a clear and well-established factual record, while avoiding speculative rulings that unnecessarily limit the flexibility required by ISPs and P2Ps to develop innovative solutions in the rapidly evolving and expanding marketplace for digital distribution of rich media content.

The purpose of such examinations should be to ensure that the Commission's broadband principles are being followed by providers of networks, services, applications, and content and that those principles are fostering continued innovation and advancement of consumer-benefiting services in a free and competitive marketplace.

Network management practices should be implemented equitably for the collective benefit of all Internet users. Network management practices should not be used as a pretext for unlawfully discriminating against particular types of applications, content, or services that ISPs may view as potential sources of competition.

By the same token, applications and services that require significant bandwidth and other network resources to deliver their large rich-media content payloads should bear some meaningful responsibility for consuming disproportionate amounts of network resources to the potential detriment of an ISP's collective customer base, and ISPs' network management practices should be permitted to take into account and manage their networks to address any such impact.

It would not be inappropriate for ISPs to receive appropriate compensation from content providers using P2P for the services and delivery enhancements that ISPs may offer to them through capabilities like P4P. Alternate, flexible financial arrangements may assist ISPs by providing the appropriate financial incentives to add significant capacity for such services in better alignment with traffic demands.

The DCIA recognizes that, given the inherent dynamism and rapid growth of the Internet, flexibility is a critical component of network management. Therefore, the Commission should avoid adopting strict network management rules that could preclude new opportunities for collaboration and new business models between ISPs and application providers that would help to improve the experience of end users accessing the applications and content of their choice over the Internet.

In light of the rapid growth in this area, the scope of its impact on important consumer services and the commercial value of the offerings thereby represented, and the potential impact of this area of activity on other vital Internet services, the FCC should seek to provide consumers, ISPs, and applications, services, and content providers with clarity regarding what to expect with respect to broadband network management practices.

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Uncertainty associated with the Commission's current rulemaking process in this area has caused US-based industry participants to temporarily reduce their active involvement is an important and effective process, which had been addressing key areas of broadband network resource utilization and related P2P software functionality under the auspices of a voluntary private sector initiative, and to slow the pace of progress.

P4P has been successfully field-tested by AT&T, Comcast, and Verizon Communications, for example, working with Pando Networks and Yale University; and key results of these trials have been published.

The accomplishments of US firms contributing to the P4PWG from 2007 through 2008 far exceeded their successes in 2009. US-based field trials, sub-group expansion, standards-setting, and related activities demonstrating genuine productivity have essentially moved offshore.

We respectfully request that the FCC act to provide the needed certainty and offer the required clarity.

Background of the P4P Working Group

The P4P Working Group (P4PWG) was established by the Distributed Computing Industry Association (DCIA) in July 2007 at the request of DCIA Member companies Verizon Communications and Pando Networks, after independently reviewing relevant research being conducted at Yale University.

The P4PWG has subsequently developed into a voluntary, consensus-based, non-profit corporate alliance, whose mission is to work jointly and cooperatively with leading Internet service providers (ISPs), peer-to-peer (P2P) software distributors, and technology researchers to ascertain appropriate and voluntary best practices for the use of "P4P" mechanisms to accelerate distribution of content and optimize utilization of ISP network resources in order to provide the best possible performance to end-user customers.

P4P is defined as a set of business practices and integrated network topology awareness models designed to optimize ISP network resources and enable P2P based content payload acceleration.

Active participants now include Abacast, AHT International, Alcatel-Lucent, Allsii, Andolis, Arrisi, AT&T, Bell Labs, BitTorrent, Bezeq International, Camiant, China Mobile, China Telecom, China Unicom, Cisco Systems, CloudShield, Comcast, Conviva, Digimeld, Digital Containers, Dow Lohnes, FlashCast, France Telecom, Fujin Technologies, Global Media Services, Huawei, Immedia Semiconductor, Itiva, Juniper Networks, Kontiki, Level 3 Communications, LimeWire, LiveStation, Manatt, mBit, Microsoft, Nokia, Orange, Oversi, Pavlov Media, PeerApp, PeeringPortal, PPLive, Qwest, RawFlow, SerNet, Solid State Networks, Sprint, Telecom Italia, Telefonica, Telstra, Thomson, University of Toronto, Velocix, VeriSign, Vuze, University of Washington, Xunlei, Yahoo, and Yale University Laboratory of Networked Systems (LANS). There are a similar number of P4PWG observers.

The principal objectives of the P4PWG are to:

1. Provide ISPs with the ability to optimize utilization of network resources while enhancing service levels for P2P traffic;

2. Provide P2P software distributors with the ability to accelerate content delivery while enhancing efficient usage of ISP bandwidth;

3. Provide researchers who are developing P4P mechanisms with the support to advance and the ability to publish their work;

4. Determine, validate, and encourage the adoption of methods for ISPs and P2P software distributors to work together to enable and support consumer service improvements as P2P adoption and resultant traffic evolves while protecting the intellectual property (IP) of participating entities; and

5. Establish appropriate and voluntary best practices for the deployment of P4P mechanisms to meet the above identified objectives in a way that can be sustained by all of the necessary participants.

P4PWG participants include ISPs, P2P software distributors, technology researchers, DCIA Member companies, and information technology firms involved in digital media platforms.

The P4PWG's bylaws serve as a framework to address vital concerns such as protection of intellectual property rights (IPR) and other related commerce, policy, and technology matters.

In order to further its mission, the P4PWG has the limited purpose of enabling P2P software distributors, ISPs, and networking vendors to address issues of optimization and load balancing of network resources to accelerate distribution of content within fixed and mobile networks on a P2P basis to provide the best

possible service levels to end-user customers. It is the explicit intent of the P4PWG to achieve this limited purpose by:

1. Developing specification(s) which describe the interfaces of a core architecture and framework incorporated into the definition of P4P to help facilitate efficient P2P traffic management;

2. Collaborating with and making contributions to standards setting organization such as the Internet Engineering Task Force (IETF) that are engaged in complementary and similar efforts;

3. Promoting P4P and multi-vendor interoperability;

4. Encouraging and promoting the widespread adoption and utilization of specifications developed by the P4PWG;

5. Developing test specifications and test suites for compliance and interoperability testing;

6. Developing and administering a compliance and interoperability testing program; and

7. Developing best practices and usage models.

As part of the specification development process, the P4PWG and its members, core participants, and observers seek to solicit the participation and comments of all interested parties on a fair, equitable and open basis.

Participation in the P4PWG was initially organized in two groups: 1) core participants; and 2) observers. The P4PWG's incorporation as a non-profit corporate alliance in 2009 created a third participation group: 3) members. Qualifying companies, associations, and other entities may now participate in these three categories.

Qualifications for core participants are that their primary business be either a) Internet service provider (ISP) providing broadband access service to consumers; or b) P2P software developer or distributor providing file-sharing service to consumers. For P4PWG core participants, there is no cost to participate in the P4PWG and no pre-requisite for acceptance into the P4PWG, such as DCIA Membership. The P4PWG is open to all ISPs and P2Ps on a global basis, subject to the approval of the P4PWG co-chairs. In addition, all DCIA Member companies in good standing are entitled to participate as core participants in the P4PWG. Core participant benefits include the rights to participate in meetings and on sub-groups; vote for and serve on the Board of Directors (BOD), and recommend meeting agenda items.

Core participants are eligible to become members of the P4PWG subject to 1) approval of the BOD; and 2) execution of a P4PWG membership agreement including payment of applicable membership dues, if any. (To date, no dues have been charged for P4PWG membership). P4PWG membership has an indefinite term, but may be terminated in accordance with provisions of the P4PWG’s bylaws. Recruitment of new members is conducted by the P4PWG with the goal of developing a balanced membership among ISPs and P2P companies, supported with a reasonable level of participation by researchers, suppliers, and vendors, which shall contribute the greatest value to the P4PWG mission.

Member benefits include the IP protections afforded under the P4PWG IPR Policy; the non-exclusive licensing of the P4P specification(s); the efficiency, reliability, and other performance improvements attributable to implementing P4P; and the rights to recommend P4PWG policies, positions, and priorities; participate in meetings and on sub-groups; vote for and serve on the P4PWG BOD; and recommend meeting agenda items. Core participants must become members in order to obtain the benefits of the PRPWG IPR Policy and licensing of the P4P specification(s).

Qualifications for observers are that their primary business be relevant to the mission of the P4PWG. This includes vendors, suppliers, and researchers. In addition, certain ISPs and P2Ps may elect to be observers rather than core participants. Acceptance as a P4PWG observer is subject to the approval of the P4PWG co-chairs. Observer benefits include receipt of approved meeting minutes and advance notification of P4PWG press announcements. Observers may apply to become P4PWG members without first being accepted as core participants provided that applicants meet the established membership criteria and are in good standing.

The P4PWG conducts approximately twelve general information meetings for members and core participants each year, generally scheduled to occur once monthly, as conference calls and meetings held at appropriate locations to facilitate P4PWG development. The fiscal year for the P4PWG is the same as the calendar year. Four of the P4PWG meetings, approximately one per quarter, are designated as P4PWG BOD meetings and include a separate session for the BOD only.

The business of the P4PWG is managed by its BOD, which consists of eleven directors. For 2009, the P4PWG BOD included Laird Popkin, Pando Networks, Co-Chair; Doug Pasko, Verizon Communications, Co-Chair; Rick Buonincontri, Solid State Networks; Jim Kott, Abacast; Marty Lafferty, DCIA; Emilio Sepulveda, Telefonica; See-Mong Tan, Microsoft; Barry Tishgart, Comcast; Steven Wright, AT&T; Haiyong Xie, Akamai; and Richard Yang, Yale University.

The P4PWG operates in accordance with its Intellectual Property Rights Policy (IPR Policy), a summary of which follows.

P4PWG Intellectual Property Rights (IPR) Policy

As a condition of membership in the P4PWG, each member agrees to be bound by the terms of the P4PWG IPR policy.

As part of this policy, each P4PWG member grants to the P4PWG and other members a non-exclusive license to reproduce, modify, and distribute its contributions for the purpose of developing and publishing draft specifications, candidate specifications, and final specifications and related materials. Each P4WG member further grants to the P4PWG the right to sublicense to adopters and to internationally recognized standards bodies the right to copy, publish, and distribute its contributions as incorporated into a final specification and related materials.

Each P4PWG member retains ownership of the copyright in its contributions, subject to the licenses and license commitments described above. The P4PWG owns the copyright in all draft specifications, candidate specifications subject to ownership in contributions, and final specifications and related materials developed by the P4PWG.

Effective upon the adoption of a final specification, the P4PWG will grant to each member an irrevocable, worldwide, perpetual, royalty-free, non-sublicense-able, nontransferable, non-exclusive copyright license to copy, reproduce, publish, and distribute the final specification for the sole purpose of implementing it or applicable portions in its hardware or software products or services.

For a draft specification developed by the P4PWG, each P4PWG member agrees to grant to other working group members a non-exclusive, royalty-free license on reasonable and non-discriminatory terms for its necessary claims on the draft specification to make and distribute conformant portions in non-revenue generating samples and/or evaluation units of its hardware or software products or services that implement the draft specification.

For a final specification developed by the P4PWG, each P4PWG member agrees to grant to adopters a non-exclusive license on reasonable and non-discriminatory terms, which may include a reasonable royalty or fee, for its necessary claims to make and distribute conformant portions of that final specification in their hardware or software products or services.

When a P4PWG member believes that a draft specification is ready to be proposed as a candidate specification, it may initiate a review period of at least 45 days. At the end of this period, the member will submit the candidate specification to the BOD. If the BOD approves the candidate specification, it shall be a final specification of the P4PWG. If the BOD fails to approve the candidate specification, it shall be returned to the originally submitting member for revision or modification.

Contributions, draft specifications and minutes of P4PWG meetings are considered non-confidential and non-proprietary information.

The P4PWG may contribute a final specification to one or more nationally or internationally recognized standards organizations as determined by the P4PWG BOD, provided that any resulting approved license shall be no greater than that which may otherwise be granted pursuant to this IPR Policy.

Members acknowledge that they compete with each other in various lines of business and that it is therefore imperative that they and their representatives act in a manner which is consistent with the requirements of applicable anti-trust laws and regulations.

Members are not obligated to participate in the development and implementation of any specification developed by the P4PWG, although they are encouraged to do so.

Members also are free to participate in the development and implementation of specifications that may compete with specifications developed by the P4PWG.

Members agree to not have any discussion relating to patent licensing terms or pricing, product pricing, methods, or channels of product distribution, any division of markets, or allocation of territories or customers, exclusion of competitors, or other topics which may be a violation of applicable anti-trust laws or regulations.

2007 P4PWG Activities

At its formative meeting in July 2007, attendees discussed the following hypotheses:

- ISPs could benefit with bandwidth savings if P2P traffic could be directed more efficiently in its use of network resources.

- P2P distributors could benefit with faster content delivery if P2P traffic could be directed more efficiently in its use of network resources.

The basic idea was to collaborate in learning how to use the least possible amount of network resources to deliver content to users in the shortest time.

Broadband carriers would need to find the way(s) to provide an abstract view of their topological data and subnet protocols to P2P software firms. P2P software firms would need to find the way(s) to develop algorithms to optimize this information for the most efficient distribution of content.

Security issues including competitive and proprietary data as well as consumer privacy would need to be protected at all times in the process. There would be no visibility into specific content being redistributed by the contemplated activities of the group. In addition to file-downloading P2Ps, live-streaming P2Ps should be involved in the P4PWG for optimal results.

The P4PWG should amplify such efforts, building on the work already done and improving upon mapping techniques, etc. already developed. ISP routing of relatively low-speed digital subscriber line (DSL) and high-speed Internet protocol television (IPTV) data and visibility into home-routers, for example, would add much value.

Licensing of such services, especially to small companies that may prefer to buy rather than make their own implementation of P4PWG-recommended best practices should be considered. Ensuring that small new P2P players have an easy and attractive way to comply should be a priority.

The group agreed to be mindful of inter-domain content delivery fulfillment issues to ensure that one ISP would not be advantaged over or at the expense of another. Simulation tests conducted by the researchers in the lab could help with this aspect. Redoing some of the initial research work with added topological information provided by ISPs could be worthwhile.

The research entity would need to serve as a kind of vault to ensure that the privacy of information contributed by each ISP would be protected, while general results, which don't contain ISP-identifying information, would need to be made available to all P4PWG participants.

Individualized results derived from work done with the contributing ISP's data would also be expected to be provided to each participating ISP. The researcher would also need the right to publish the general results with data-source confidentiality ensured at that juncture as well.

The researcher would like the ability to propose enhancements and more advanced research coming out of the prescribed simulations. Participating companies would like the right to approve or disapprove such activities above and beyond what has been prescribed.

Work needed to be done to stipulate, define in advance, and document by written agreement the rights of participants on several levels, including but not limited to information sharing – as well as the scope of the business practice(s) to be recommended to be adopted as a standard by the group.

The group should also look at what P2Ps can do if some ISPs don't provide any topological data. To be successful, recommended best practices would need to directly and equitably benefit each ISP and each P2P that participates.

The group agreed to stay focused on a work product that would be beneficial for general use by broadband carriers and P2P software distributors. This could be a logo'd compliance program, perhaps with tiered levels, and certain components that are mandatory and others that are optional or voluntary.

Given that determining what topological data can be shared and what will prove most useful is akin to defining a lightweight routing protocol, it was noted that it would be advisable to also involve one or more router vendors. The DCIA agreed to also commence a recruitment effort on this.

For the next step, participating ISP representatives and participating P2P representatives each committed to complete this assignment:

> *For the ISPs, please list the top ten or so "headaches" caused by P2Ps – i.e., what are your greatest concerns, complaints, questions, etc. about the way P2Ps use your networks?*
>
> *For the P2Ps, please list your top ten or so "wish-list items" that you'd like from ISPs – i.e., what would be the most helpful information, procedures, policies, etc. that ISPs could provide to you?*

Ultimately, P4PWG wants to provide real world implementation of multiple ISPs and multiple P2Ps that benefits all participants and their end-using customers.

Along that path, it may make sense to start with pairings of a single ISP and single P2P working on proof(s)-of-concept(s) with small subsets of subscribers, perhaps tightly defined geographically (assuming appropriate test content can be identified and acquired as an exception to the rule for this purpose).

The timeline for obtaining real-world results of such preliminary one-and-one pairings would be expected to be a matter of a few months.

The group closed its formative meeting by agreeing to revisit and seeking to refine at its next meeting the agenda items preliminarily discussed during this meeting regarding initial deliverable(s), timeline(s), resources, and success measurement(s).

In August, preliminary results of the ISP and P2P lists were discussed.

The ISP sub-group list included:

- How do we define first steps (walking before we run) in terms of what can be done to decrease the impact of P2P on network capacity usage?
- How can we leverage the fact that not all broadband consumers are created equal: DSL customers have much less upstream bandwidth than FiOS customers for example?
- How can ISPs reduce their costs of running networks with P2P?
- How can P2P peak demand for capacity be reduced?
- How can back-office controls be developed that will aid in enabling P2P traffic control, for example by understanding predictability?
- What kind of information must ISPs provide for P4P to be tested and implemented?
- How can the amount of proprietary information be minimized without impacting the benefits to be achieved?
- Which P4P solutions will be the simplest and easiest to implement with the greatest value?

- Will solutions be fault tolerant?
- How can the cost of solutions be minimized?

The P2P sub-group list included:

- Can ISPs tell us what each user's class of service is? (e.g., dial-up, DSL, other broadband, corporate, fiber to the home [FTTH]? Or exact uplink and downlink rates?)
- Are ISPs deploying P2P caching technologies? If so, which protocols and how can P2Ps help optimize the benefits?
- Are ISPs deploying traffic-shaping technologies that affect P2P traffic? If so, what is the policy for selecting which P2P protocols to shape?
- Can ISPs tell us about low latency routes between peers (e.g., optimal control messaging)?
- Can ISPs tell us about high throughput routes between peers (e.g., optimal data delivery)?
- How can we most accurately trace-route through ISP networks?
- How do ISPs prioritize packets? What packets can get through under what circumstances?
- Can we flag transmission control protocol (TCP) packets with QoS flags? (QoS, terms of service [ToS], etc. Note: we're potentially willing to mark our traffic bulk if we're advised how best to do that).
- Do ISPs automatically drop user datagram protocol (UDP) traffic in the face of TCP traffic?
- Do ISPs do anything to restrict serving from the home (e.g., receipt acknowledgment [ACK] traffic)?
- Do ISPs prefer any port numbers?
- Is there any way to recognize that a particular hop is especially expensive for an ISP? (If we can determine that, we could try to route around that hop).
- What kind of P2P traffic or activity are ISPs most concerned about?
- What are ISPs blocking or considering blocking?
- What does a P2P system need to do in order to be considered a friendly P2P system an ISP would choose not to block?

There was consensus that the working group should focus on the most readily attainable positive changes. If we could obtain an 80% improvement with actions characterized by ease of implementation that would be preferable to holding out for 100% if that involved a much greater degree of difficulty.

Deadlines were set for the above 2 lists to have the benefit of obtaining more input from additional companies and being refined by their respective sub-groups. Then each list would be transferred to the leader of the other sub-group to develop preliminary responses to discuss at the next P4PWG meeting.

Additional discussion centered on the process for obtaining network topology information from participating ISPs to provide to the research team to integrate into its code, for the research team to perform simulation

studies, and for participating P2P(s) to integrate instructions into a tracker that, for example, performs a software update for testing purposes.

The basic idea would be to enable a comparison of metrics with a P4P-enabled P2P software update or other file transfer versus a non-P4P-enabled P2P software update or file transfer through analysis conducted by the research team to ascertain the efficiency improvement.

In terms of timelines, 2-to-4 weeks was the estimated time for the ISPs to complete their non-disclosure agreements (NDAs) with the research team, receive necessary internal approvals, and obtain, format, and provide their data. Care would be taken on several levels to protect and ensure the security of the data. For the topology and trafficking data to be as valuable as possible, it should be detailed to the level of points-of-presence (POPs) and links, either with actual information or estimates.

1-to-2 weeks was estimated as the time for the research team to accept the input data from the ISPs and convert it to the current format used for simulations, and to run the simulations to confirm that the proposed test indicated sufficient prospective benefits to proceed.

During this time period, the P2P(s) would work to organize their participation in the field test, including making the determination of whether to involve one or two P2Ps at this point, and which one(s), and to coordinate with the research team and the DCIA with regards to all relevant operational and procedural considerations in order to be able to proceed as efficiently as possible. Parameters for the output data for the participating P2Ps would be defined so as to make the results as valuable as possible to the P4PWG.

No additional resources were required by participants at this time. Looking ahead, as recommended business practices would be established and to be communicated to the industry and compliance monitored, added resources would be necessary.

The DCIA website Activities page P4P Working Group section link from “P4P Overview” was changed from a preliminary slide presentation to a more detailed white paper.

The research team established a wiki to use for communications of P4PWG work. It was the consensus of participants to limit access to this wiki to P4PWG participants-only at this time to facilitate the most beneficial use of this communications tool.

There was no September meeting. At the October meeting, assignments from the August meeting, initial work product, timeline, and prospective expansion plans were discussed.

Constructive input came from the product marketing area where there was a parallel in terms of guidelines for equipment. The basic idea was to provide a set of options from which P2Ps could select their preferred method(s) for network traversal.

There could be incentives for the software equivalent of an energy star logo program, which in the hardware realm is used to recognize compelling hosting products.

The focus of the P2Ps increased on quantifying performance benefits from P4P for the benefit of both software distributors and carriers. The consensus of the P2Ps was that ease of implementation would be paramount to ensure wide-scale adoption.

The ISP and P2P lists were posted on the P4P wiki and participants were encouraged to add to them going forward.

One ISP and the research team completed their NDA as the prerequisite for the next phase of simulation studies. It was expected that input data for the next phase of simulation would begin to flow in the next few weeks. Another ISP had been able to compile data to submit with greater detail than it provided previously – down to the city level.

One of the first metrics to quantify would be to compare the relative efficiency of a number of P2Ps in two states of operation: 1) with and 2) without P4P – other things being equal (OTBE) as much as possible.

There was discussion of the potential expansion of the modeling, once the next group of results had been obtained, to features other than topological – a kind of P4P routing system.

It would be worthwhile at that point to also compare the P4P results with other studies and other potential solutions, although P4P is more advanced and ambitious than others.

It was noted that leading P2PTV services were in a position to make very effective use of the topological data to improve the efficiency of their offerings. Simulation comparisons would be worthwhile for this category as well as other types of P2P. In addition, P2P self-adaptation efforts could be reviewed and compared to those that benefit from ISP input.

It would be most beneficial if P4PWG could drive towards a standard way for the carrier world to share data with the P2P software world and offer a number of ways to implement solutions to be approved or qualified as complying.

Once the P4PWG had completed the next wave of modeling results, and provided that they continued to be compelling, the group agreed that it should go out to other companies and increase participation. As part of this expansion, there could be a 2 or 3 layer approach once the P4PWG had discovered certain basic levels of information.

It was noted that there was very little geo-awareness in certain P2P networks, and as a result steps were taken *in vitro* using self-generated data. There could be significant benefit to long-tail storage networks that may expand beyond pure P2P as well.

It was clear that publicly available data had much information missing (which in part increased the opportunity for P4P to add enormous value), such as P2P links. In addition, that info could be misleading since it could be skewed by the size of the networks, locale, etc.

The top priority was to complete the next phase of simulation results.

1-to-2 weeks were estimated for the research team to accept the input data from the ISPs and convert it to the current format used for simulations, and to run the simulations to confirm that the proposed test indicates sufficient prospective benefits to proceed.

The next major step thereafter would be to compare the results obtained to alternatives.

In October, there was a consensus to focus recruiting on one or more international ISP participant(s), and to enlist DCIA Member companies providing P2P-related services to invite and host their participation.

To summarize the major next steps: before-and-after ISP topological data P4P simulation analysis by the research team, followed by real world experience and analysis of a file being redistributed via P2P during several weeks duration to validate simulation premises.

In November, new attendees commented on their objectives for participation in the group:

> 1) Understanding ISP topology policies for peering points to optimize efficiency of P2P traffic streams (ultimately through a reverse domain name system [DNS] or the like).
>
> 2) Lowering infrastructure costs (including for long-haul), optimizing network utilization, and enhancing P2P user experiences by using most economical routing paths.

3) Improving upon the need to infer how networks facilitate content distribution with more accurate information about network architectures and potentially standard table definitions.

A major ISP submitted to the research team relevant topology data to the street level for 40,000 Internet protocol (IP) addresses with a mix of fiber and DSL connections for the current simulation study.

A popular P2P client with tracker was being used for the current simulation. A standard file size of 256 megabits (MB) was being used.

The current study involved 5 times more information than had been processed previously and was taking more time. Initial results showed performance improvements with P2P clients using P4P in terms of download times once the number of users increased above 600-700.

Download time could be as little as 1/6th the time with P4P as without. P2P traffic demands on the network could be reduced by half. A concern was voiced that with the particular P2P protocol, which was currently being tested, each file essentially had its own P2P network, and other protocols with different characteristics should also be tested. The observation was made that benefits would be optimized for more popular content.

An ISP and a P2P company agreed to explore the commencement of real-world testing targeted for January using the current simulation-study user-base from the ISP. The P2P firm would provide an iTracker (which directs peers as to which other peers to connect to) and content.

Researchers would provide the P4P simulation and topology maps for this test and dedicate resources for processing the data. They would also provide the needed P4P pTracker.

Results would include a snap-shot of performance with and without P4P, comparing efficiency and throughput. Comparison of comparable non-P4P results from December would be made.

Sharing of any results data by the research team with the rest of P4PWG would only be by consent of participating companies. Sharing results beyond P4PWG was not contemplated at this time. Full logs of iTrackers would show net flows. Other ISPs and P2Ps would be invited to participate as well.

The following points were discussed:

- The need for and relative economy of a discovery mechanism for caching solutions (versus expanding plant capacity), and the placement of such enhancers in the network (or on the edge or side) without the consumer having to take any different action and how to adapt P4P for caching.

- The impact of international backbone connectivity and performance and its effect on loads in individual countries and geographic regions, digital subscriber line access multiplexer (DSLAM), and last-mile issues.

- An additional idea for testing to create two identical torrents to test side-by-side in partitioned cells, one with P4P and one without (two nearly identical swarms with just one bit changed); and then compare what the P2P client would have generated to the ISP with and without P4P.

- The importance of various considerations that affect scaling, and again, the strong need for the network topological information provided to P2Ps to be as simplified as possible.

- The full impact of content popularity (hypothesis – that 1,000 files make up 90% of demand).

- The degree to which P4P's benefits would be largely local and the recommendation to evaluate impact on sharing by devices that were very near, moderately close, and far away from each other (hypothesis – that P4P will have the most impact on clusters of 1,000 users).

- The question of whether proximity or latency is the more important concern and whether and how these relate. Packets being dropped being the critical issue.

- The differences among P2P protocols (e.g., the lack of look-up tables).

- How to help defuse the negative publicity emanating from press reports about a particular ISP "throttling" a popular P2P software application and involve the ISP in P4PWG to work constructively towards more beneficial solutions.

It was noted that the P4PWG seeks to engage ISPs and P2Ps in mutually beneficial activities reflecting the reality that many networks were not built to deal with the type of software solutions and traffic levels that are emerging as technology advances.

In December, discussion centered on the advanced simulation study and the proposed January field test.

A co-chair reported on experience at the European Peering Forum, where a number of ISPs voiced concern that P2P is a resource drain and reaffirmed their interest in seeking a software fix.

Carriers from Norway, Israel, and Australia were particularly interested because of their relatively high bandwidth costs.

The research team reported that for the current simulation test, which used data from multiple ISPs, the number of peers had ranged from 500-to-1,500 and the file size had been 12-15 MB. A single tracker and P2P protocol were used with TCP to compare through-put. Results were consistent with previous findings.

Current simulation studies indicated that using P4P could improve completion time for file downloads by 1/3-to-1.5 times – about a 30% improvement. In addition, intra-ISP bandwidth usage with P4P, which was measured as traffic between links, indicated a 50% savings.

Distances between links could also be calculated to help provide additional information regarding potential cost savings. Backbone link capacities were used to achieve the savings along with all other links in the current simulation.

For now, no policies had been imposed to prioritize what capacity could be used to achieve the savings. Inter-domain policies could also be implemented. Background traffic had not been taken into account yet in the cost savings determination.

Results from additional ISP data were to be available in approximately two weeks. P4P researchers were working to improve small-swarm performance. The top 1-to-2 swarms appeared to contribute 50% of the traffic.

As the next step, researchers needed to know policies for inter-domain and intra-domain usage to assist with analysis and savings optimization. The research could also recommend policies starting with descriptive questions about detailed link utilization policies. The researchers would take the responsibility to translate ISP-provided verbal descriptions into mathematical assumptions and formulae. It was important to have a common language for defining peering points in the same way among ISPs.

At a high level, P4P could be described as an optimization of best practices. P2P companies' use of algorithms and how this differs among different applications would also be examined. Comparisons with other P2P awareness studies and research papers would be conducted. Pure peer locator alternatives may not be the best in terms of cost savings.

For the upcoming field trial, multiple ISPs and multiple P2Ps would have the opportunity to participate at a variety of levels. It would also be possible for iTrackers to be test-evaluated by ISPs prior to the field trial.

2008 P4PWG Activities

In January, the P4PWG conducted a review of highlights from the first six months of the working group.

The overview presentation was posted online here: http://www.dcia.info/activities/p4pwg.

The original requirement summaries generated by initial ISP and P2P participants in the P4PWG were also posted.

The threshold of a swarm size for P4P to make a positive impact was currently 500-to-600 users.

Discussion addressed the need to reset performance parameters so that P4P would never be less efficient than unassisted P2P, even when swarms were very small.

In addition, the group discussed its upcoming P4P field test.

In follow-on discussion, an additional ISP agreed to participate in the field test. Multiple ISP data, with multiple topologies as well as multiple POPs, would make the test more valuable. Data giving a holistic view as well as sorted for individual ISPs would be important.

The need to conduct additional simulation tests with more varied and real-world-like assumptions, as well as additional analysis, was also discussed.

The field test was tentatively set with one additional pre-launch update P4PWG meeting to be held for final input from P4PWG participants, plus one possible additional pre-test meeting or call.

Initial results of the field test should be available by early March. Raw data would be retained for several months to allow additional analysis.

The discussion reflected a consensus view that the field test would be the final step for the core P4PWG group to take before taking P4P to a larger community of interest. This would include additional alternative solutions as well as expanded participation.

The issue of international traffic as a factor needed to be tested as well as inter-ISP traffic.

There could therefore be two sets of results – one dealing with internal-only traffic, and one dealing with traffic that was intra-ISP in various circumstances.

Link utilization information would be required for this: intra-connect plus access links. The objective would be to yield the best connections without limiting traffic at one extreme or another.

And finally, there was a discussion looking to the future, regarding P4P deployment models.

A caching solutions provider gave a presentation. An element that had been missing in the P4P approach so far was the use of caching. It was noted that deep packet inspection (DPI) becomes increasingly challenging as a solution for bandwidth management as commercial P2P is increasingly deployed.

Caching can offer an enormous savings and up to 150X faster delivery of content. New monetization models can be supported. P4P can be integrated with caching information to be even more effective – particularly in saving on the uplink side. There can be up to a 200% improvement in iTracker performance.

The suggestion was made to add a definition of caching to the P4P approach and map implementations with each vendor providing their data and a plug-in being created for caching. There was additional discussion to work more closely with DPIs as well and learn to focus their work more precisely on unauthorized content.

A competing caching company also gave a presentation. This firm worked closely with DPI vendors and could benefit P4PWG in that way. Caching and swarming together represent very major content delivery efficiency improvements.

Efficiency could be enhanced by pre-populating environments with predictably popular content. Peak management was an important area of consideration as well. Delivering certain content types in a batch mode overnight could generate savings.

In February, the P4PWG co-chairs accepted an invitation to present at the North American Operations Group for ISPs (NANOG) in order to increase awareness of the P4PWG and to recruit additional participants. They led a review of their proposed NANOG presentation for P4PWG participant input.

There was a discussion of the final preparations for the field test to be conducted during February. Researchers received network data to load into the iTracker.

The P2P client was readied for conducting the test. The process was established for results to be transmitted to the research team for analysis. Alternatives to be compared included the native P2P client (without P4P) and that client with P4P. Data sets that would be used in the analysis included: 1) the P2P client log, 2) network topologies, and 3) iTracker log. Sources for the data sets were 1) the P2P client log: collected by the P2P company, 2) network topologies: obtained from participating ISPs and derived from public border gateway protocol (BGP) route views by the research team, and 3) iTracker log: from the research team.

The targeted analyses would encompass:

1) Common P2P objectives --
   - compare download completion times of all three (or more) alternatives;
   - compare offload ratios of P2P client's seed servers

2) Common ISP objectives --
   - compare traffic volumes incurred on ISP backbone and inter-domain links
   - compare maximum link utilizations
   - compare the average distance a unit of traffic traverses

3) Specific ISP objectives --
   - protect a link (e.g., P2P traffic load upper limit on a link)
   - compare effectiveness of different alternatives
   - other objectives (TBD)

4) Load on iTracker

5) Plans for next-step field tests and analyses

There was a discussion of P4P-like local peering heuristics: the basic idea that either the iTracker or pTracker could support local peering (e.g., assign a different set of weights to guide clients peering with each other). The weight could be for instance: 1) inversely proportional to end-to-end latency/distance; or 2) subnet prefix matching.

Caching infrastructures were also discussed in the context of a capability interface designed to handle ISP/3rd party's special circumstances (e.g., caching infrastructures or seeds with high capacities).

International flows and links (e.g., how much kept within a domain) were also discussed as important for follow-on work with sufficient topology data to address this aspect.

The option was left open to schedule an additional brief call just prior to the field test if needed (this was not necessary).

Discussion of P4PWG enhancements included formalizing IP guidelines and policies for the working group to support and help facilitate progress and further expansion.

In March, the P4PWG co-chairs reported on their NANOG presentation. 40% of attending carriers said they wanted to participate. A large number of ISPs and research organizations requested additional information. As a result of NANOG, the number of companies participating in P4PWG surpassed 50.

There was a brief discussion of the FCC fact-finding process regarding broadband network management practices and various P4PWG participant submissions. The sense of the P4PWG was that the private sector, exemplified by initiatives such as this, needed to be able to develop technological solutions and business practices to address these types of issues.

There was a discussion of initial results for the field testing, which was proceeding in advance of any standards setting activities in order to rapidly validate simulation studies. It was anticipated that there would be many other valid contributions and multiple ways to approach this.

Top-line results, based on approximately 200,000 content downloads through the participating P2P service's automated video delivery channel of a 20 MB file to 3 randomly chosen swarms (native P2P, GeoIP P2P, and P4P), included the participating ISP's traffic patterns dropping from 5.5 hops to 0.89 hops in the tested metro area, and a 23% improvement in the P2P client's download rates.

The P2P company also did tests using GeoIP mapping data in areas where specific ISP topology data had not been made available, which also showed promise, particularly from a caching perspective, and which showed several surprises (e.g., Hong Kong had exceptional results).

P2P performance increased in areas with good bandwidth. In some circumstances, broadband customers had better results when downloads had come from external rather than internal sources.

The participating P2P firm agreed to organize and publicize the GeoIP results. An additional ISP's P4P results would also be processed and analyzed for P4PWG review at the next meeting.

This initial testing represented a preliminary litmus test with limited data. It did not use distributed hash tables (DHT), only central trackers, but DHT could be integrated going forward. A lesson learned was that the iTracker needed to be on a dedicated server to guarantee reliability and balanced loading.

There was a discussion regarding the addition of caching into a future set of field trials to show the beneficial impacts that caching could bring to bear. An ISP-located iTracker could track related information. Discussion points included whether caching would be more valuable with larger files or smaller files, and with access limited content versus widely available content. In simplistic terms, the cache could be treated as another peer, like a super-node.

For the next round of testing, the P4PWG would start by establishing a set of requirements. That work would proceed using the wiki, e-mail, etc. and be discussed at the next meeting.

A sub-committee was established to develop P4PWG IP policy / guidelines to protect participants as growth continued, and to further discuss this at the next meeting.

Also in March, Verizon Communications reported results of its preliminary P4P field tests.

"The results of the testing have been phenomenal," said Douglas Pasko, Verizon network designer and co-chair of the DCIA-sponsored P4PWG. "Customer and network benefits were seen as soon as the test began. This new system that routes files along the fastest, least expensive path, offers our FiOS customer

an average boost for P2P download rates of 60%, decreasing the time it takes to download files and could cut network delivery costs of P2P content by as much as 50%."

According to Pasko, the end result of the experiment and ultimate implementation could be "carrier-grade P2P" once focused routing and handling replace arbitrary delivery paths.

"The collaboration of various network and sharing companies through this effort indicates great promise for this distribution model because the more networkers who deploy it, the more the benefit accrues to the networks and the customers," said Laird Popkin, CTO of Pando Networks and P4PWG co-chair.

"There are more than 50 organizations engaged in the working group and that kind of curiosity and engagement shows how aware the industry is to the need for efficiency and speed in P2P delivery."

"It makes no sense for a customer to arbitrarily download a file from Singapore, consuming bandwidth on high-cost, high-traffic routes like Pacific undersea cables when the file is stored right down the street and can be accessed more quickly and cheaply," Pasko said.

In a report to the DCIA on the trial, P4P Working Group co-chairs Pasko for Verizon, and Popkin for Pando Networks, and Haiyong Xie, Yale researcher, reported that the field test had clearly validated the value of P2P networks and ISPs working together to provide the most efficient, highest quality service to their customers.

"We can get this right and spare carriers and ISPs the kind of oversight and mandates that come when industries don't manage their own issues properly," Pasko said. "We have to make P2P work so others don't step in and try to make it work for us."

In the April P4PWG meeting, representatives of another major ISP outlined their plans to migrate to protocol agnostic network management by year-end 2008, and to upgrade their upstream capacity management. The new network management technique was being trialed at the time to be rolled-out by the end of the year.

A leading P2P company described its improving relationship with this ISP as now ongoing and focused on integrating network management with applications, while recognizing the dominance of user control in the P2P environment. The intent was to develop recommended approaches that other industry parties could review and choose to voluntarily adopt.

In recognition that the P4PWG had now grown to more than 80 individual active participants with approximately 60 companies involved as core members and observers, a proposed reorganization plan to create sub-groups to leverage these resources and improve productivity was further discussed.

This would enable the P4PWG to accomplish more by having several activities and meetings occurring in a serial rather than exclusively sequential manner.

New recommendations for P4PWG sub-groups were made by participants for caching, telco, cable, standards-setting, research, and live P2P; in addition to the previously discussed IP / policy guidelines sub-group and wireless / mobile sub-group.

Discussion proceeded to further define these sub-groups. The consensus of attendees was to continue to have the process open to volunteers from among the full P4PWG for additional participants in each sub-group, which could include expressing interest in leading the sub-group with the idea that each sub-group would determine its leader.

P4PWG participants were encouraged to contact the P4PWG co-chairs or DCIA facilitator with questions and to sign-up.

The overall goal was to have sub-group participation established and leaders identified by the May P2P MEDIA SUMMIT and have further discussion around objectives and process for the sub-groups at the May P4PWG meeting.

Discussion proceeded to discuss results of the March P4P field test in Peru as presented in detail in the report distributed by the lead P4P researcher before the meeting.

While ISP improvements were dramatic, P2P benefits were less significant in this particular test because of the small swarms involved (averaging 15 users).

The suggestion was made as P4PWG goes forward to compare results against a baseline of random peering and then demonstrate various levels of topological information involved in improving performance to show the spectrum of relative benefits versus the effort, complexity of interface, and coordination required. (i.e., a hybrid or in-between-random-and-full-P4P).

There could also be a static map of network topology versus a dynamic real-time updated map that would be valuable to test. Different network types (cable, DSL, FTTH) needed also to be further differentiated along these lines.

Planning for additional tests to involve more ISPs and more P2Ps was underway for June. Interested parties were invited get involved using the wiki or by contacting the P4PWG co-chairs.

NANOG invited the P4PWG to participate in its next event. P4PWG participants were also being asked to speak at the Voice Peering Forum.

In April, Pando Networks released results of the global P4P field test to improve P2P performance on broadband networks.

The results show increased delivery speeds by up to 235% across US cable networks and up to 898% across international broadband networks. The results also showed Pando's ability to use P4P and Pando Network Aware technology to route data internally across the broadband networks instead of pulling data from external sources that put more strain on the networks.

For example, across US cable carriers, Pando increased the percentage of data routed internally across their networks from 2.2% to 43.4% of all downloads. This optimization reduced inter-ISP data transfers by an average of 34% (up to 43.8 % in the US and 75.1% internationally) demonstrating that network awareness provides significant network efficiencies for all ISPs.

The released details represented the complete test that was conducted globally and featured data collected from more than 3,000 ISPs worldwide. The technology used was developed by engineers at Pando Networks based on research from Yale University.

The impact of this new system was wide-ranging. It would make the Internet a more scalable media distribution platform while benefiting various online media constituencies. It would help ISPs reduce network operating expenditures as well as enable content owners to distribute longer form, higher quality content.

As part of the test, Pando Networks delivered video content to more than 1 million people across global broadband networks including AT&T, Bell Canada, Bezeq International, BT, Cablevision, Comcast, Cox, Orange, Sasktel, Telefonica, Telecom Italia, Time Warner, Tiscali, and Verizon. Pando used ISP-supplied topological data for some of the networks, such as Verizon and Telefonica, while using proprietary Pando Network Aware technology to deliver content across other networks such as Comcast and AT&T.

Commenting on the release of the results, executives from industry leading ISPs indicated support for the initiative and a willingness to participate in more testing.

"Having been involved in the P4P Working Group since its outset, we are very pleased that the initial field tests have validated the extensive simulation studies conducted prior to this important step. We're interested in approaches to content delivery that are good for users, content providers, and network providers. These trials are a first step in that direction," said Charles Kalmanek, Vice President - Internet and Network Systems Research, AT&T Labs.

"These newly released test results demonstrate the applicability of P4P to cable ISP infrastructures. The initial results are promising, and we look forward to continuing our mutual efforts with P2P companies distributing legitimate content in order to improve the efficiency of their applications on our network," said Tony Werner, CTO at Comcast Cable.

"We are particularly pleased with the positive indication of these expanded test results for international ISPs with multiple diverse broadband operations in multiple territories, given our unique requirements for balancing internal and external traffic loading to optimize user quality of service (QoS) and infrastructure usage," said Emilio Sepulveda, Senior Manager Strategy & Business Innovation, Telefonica International Wholesale Services."The results of the testing have been phenomenal," said Pasko of Verizon. "Customer and network benefits to our large US-based telco broadband network were seen as soon as the test began."

"These results signal a historic turning point in the history of P2P" added Robert Levitan, CEO of Pando Networks. "Finally, ISPs and P2P technology providers can work collaboratively. Our goal is an important one: scale the Internet into a better media distribution platform."

Later in April, Telefonica reported its results from its initial field test of P4P on Telefonica's broadband network in Peru. The results showed that the new P4P protocols increased network efficiency by shifting traffic from external to internal links and by routing the internal traffic shorter distances across the Telefonica network.

The amount of data delivered from internal versus external links increased by 268%. In addition, the data delivered across the internal Telefonica network was delivered across fewer network links, thus resulting in a reduced load on the network backbone.

Specifically, with P4P protocols, the localized or "cross-metro" data delivery increased from 1% to 36%. The distance the data traveled, measured by metro hop count, decreased by 57% from 3.78 to 1.62. The results on Telefonica’s network further confirm that P4P can provide significant network efficiencies for all ISPs.

In May, an agenda and objectives for Caching Sub-Group prospective participants was developed for this initiative that had attracted 4 volunteers so far.

The Standards Sub-Group would work to develop a consensus understanding of how standards should be defined, taking into account the discussion at the upcoming IETF P2P workshop. It could be advisable to develop multiple standards. Topology map standardization should be explored. An early goal would be a roadmap of how to proceed. The Standards and Research Sub-Groups would also look into the possibilities of centralized and decentralized data repositories.

The Research Sub-Committee was in its forming stage. Preliminary objectives would be to promote flexibility and to encourage new solutions.

The IP Policy / Guidelines Sub-Group made a presentation.

The list of interested of ISPs for the June test was finalized. The data format was being defined. The research team or participating ISPs could operate the iTrackers for the test. The P2P company would deliver 1 million-plus users. A larger file than the initial tests would be used (200 MB). Data would go to the research team for interpretation. Subsets of users would have the P4P map vs. normal P2P to evaluate

differences, with possibly a third subset using simulated maps. Static vs. dynamic would be explored. Input was sought on other scenarios to test.

For follow-on tests of different P2P applications and protocols after the June test, 3 additional P2P services voiced interest. Other third-party testing agency(ies) could also be involved.

P4PWG members were contributing input to the IETF P2P Workshop with 1-to-5 page submissions. 5 P4PWG participants planned to submit.

A presentation regarding set-top boxes (STBs) with P2P inside for telco deployments was given. The EU was helping to underwrite the project and 2 P4PWG participants and DCIA Member companies were part of the consortium (P2P Next). There was dedicated storage in the gateway, enabling the preload of movies and transfer from box-to-box not to overload networks. The STB vendor was developing algorithms and working on optimization. Each box was a virtual machine with one slice for video-on-demand (VOD), one for UGC, and one for gaming. The vendor had demonstrated a proof-of-concept and would have trials with 1 or 2 ISPs. ISPs may want to integrate with the nano data center.

ONO was identified to be a point of discussion at the next meeting (it used a leading CDN's DNS to locate peers in a pure end-point optimization regime and did not provide for ISP policy specification as does P4P).

In June, the first sub-group reports were given. Smaller meetings of sub-groups between P4PWG monthly meetings were encouraged.

9 members had signed up for the Live P2P Sub-Group. The first conference call was conducted with 6 participants. Questions coming out of the call included who on the research team would be the principal contact for supporting a P4P trial of live streaming P2P. A point-of-contact person was identified.

A representative of the Caching Sub-Group visited with the research team for a day of informational meetings.

The Telco Sub-Group sought a facilitator among telco P4PWG participants. The Cable Sub-Group conducted a second round of volunteer sign-ups. They were interested in evaluating the current field trial results and then committing people as appropriate for next steps.

The Standards Sub-Group participated in the May IETF P2P Workshop and a P4PWG co-chair presented there. There was a consensus at this meeting that IETF would pay attention to the issues surrounding peer selection and congestion management. Peer selection was a relatively new idea. P4P standardization should start now and develop carefully. 3 options for contributing to IETF included: 1) writing requirements for peer selection from P4PWG; 2) solution proposal of at least as a straw man concept; 3) Standards Sub-Group subscription to IETF to follow what was happening.

The Research Sub-Group had a diverse membership of about 12 participants with a number of ideas. 3 meetings had taken place and 1 was proposed for the following week.

Regarding the upcoming field tests, participating ISPs were getting iTrackers up and loaded, with that work expected to be completed in a week. The research team added a mechanism to support external routing. The test would proceed thereafter. The new field trial plan would be posted on the P4P wiki shortly. The test file would be larger than that used in the previous tests.

In July, the Live P2P Sub-Group was in process of exchanging and executing NDAs and its progress was encouraging.

There was a preliminary investigation to understand whether P4P would be appropriate for adoption on consumer premises equipment (CPE) hardware devices like residential routers. While there appeared to be some opportunities, the transactional model that underlies P4P made it a very natural fit for end-nodes but

not a natural fit for intermediate nodes, particularly those devices that were not designed to operate application layer network utilities efficiently.

Intermediate device implementation would involve proxying much of the session set-up, which would result in protocol-specific code, benefiting some P2P applications but not others.

To complicate matters, residential routers are a well-characterized device class today, making it potentially more difficult to convince manufacturers to add specific features without a strong incentive such as an overall increase in performance, lower cost, or a differential selling advantage. The P4PWG welcomed additional members who could lend different perspectives.

While considering the role of the residential router in P2P transactions, the matter of network address translation (NAT) traversal was also discussed. While this was not a P4P-specific discussion topic, the Internet gateway device (IGD) protocol, part of the universal plug and play (UPnP) specification and already implemented on a majority of residential routers, was also discussed. IGD is implemented on many routers and enabled by many manufacturers. Given the benefit of IGD to all P2P applications, there was a recommendation that the DCIA should take a position with this hardware community to drive a higher percentage of manufacturers to enable this functionality out of the box.

Much work had been underway relating to the current field tests among the Telco Sub-Group. The Cable Sub-Group had recruited 7 members and planned to evaluate the results of the current in-process field tests and develop its strategy and action plan taking into account those results.

The Standards Sub-Group had been quite active and intended to have a report internally approved for distribution at the next P4PWG meeting with the framework for P4P as a solution proposal. A requirements document was in process to be presented during the IETF July meeting, which a P4PWG co-chair would attend. 2 more participants had been recruited to the Standards Sub-Group.

The Research Sub-Group now had a diverse membership of 21 participants and was preparing several paragraph-long vision statements.

The IP Policy / Guidelines Sub-Group had developed and was circulating a draft IPR policy internally that would be ready for review by the P4PWG before the time of the next meeting.

Regarding the ongoing field tests, multiple ISPs had launched and were collecting data successfully, with iTrackers operated by the broadband operators. Modifications were made to improve the testing. The 2 weeks of data collection would be complete this week, after which a week of analysis would be performed. There were 5 swarms. Analysis of the first week's data had begun with ISP review to come next. The results looked favorable. Some early results (from the first few days' data) were being reviewed with the ISPs. Improvements to the P4P implementation had resulted in significant improvements in transit reduction and performance improvement over the first test.

The follow-on test to be conducted after this one was complete would involve additional P2P protocols.

In August, the test cells compared 3 variants related to P4P. The test involved 4 iTrackers running with 4 ISPs, and worked very well across the board. Top-line learning included that P4P can ship less expensively than previously anticipated.

If there was no input from an ISP from which content was received or transmitted, that ISP was treated as a single location for purposes of the test. Otherwise the P4P map allowed for optimization within participating ISPs. The test differentiated between generic and tuned models, with tuned in the minority of cases.

It was expected that individual participating ISPs would elect to publish their findings. Going forward for tests of other P2P protocols and live P2P, there should be a minimal effort of currently participating ISPs to

continue participating. In addition, it would be possible to continue to run selected data by current participants.

IP discussion included who should hold the copyright to P4PWG info. If it was to be the P4PWG itself, the working group would need to be incorporated. Plans were discussed for an upcoming meeting and/or conference call of the IP Policy / Guidelines Sub-Group.

2 P2P companies committed to participate in the next trial of P4P with live P2P streaming. Live would be slightly different from the other trials because in live, it is not possible to push a file as it had been in the on-demand trials. A pending decision was to determine what live content to stream and whether to choose a single event and split the recipient groups in half or choose two similar events. Active participants were encouraged to provide relevant data. A second important decision was which ISPs would participate.

There were two P4P-related discussions at IETF Dublin – an application-layer traffic optimization (ALTO) meeting and a birds-of-a-feather session (BOFS). There would be another meeting in Minneapolis in November, then another session in March. IETF standards would represent a formal model and typically take two years. The discussions were encouraging and indicated that the P4PWG should be able to be successful in expanding P4P to include an IETF component. IETF is not an operator of systems or services, but rather a determiner of specs.

ISPs would continue to have the flexibility of either running their own iTrackers or not. Plans were in process to test other P2P protocols. P4P could apply as well to enterprise environments and corporate information as to open networks and downloadable and streamed content.

In September, the Standards Sub-Group worked on preparing a spec that would be kept as basic and fundamental as possible for maximum acceptability and usage.

The most recent field tests had now completed the data-gathering phase. The research team was continuing to analyze results, which were positive. Public announcements of test results could be made by participants, if they choose to do so, in October.

The research team outlined considerations for the live P2P tests coming up. There were two levels of integration involved for this. More details among prospective participants would be explored and reported at the next meeting.

A modified P4P implementation was now proceeding in China.

In October, multiple ISPs and P2Ps agreed to participate in developing plans for the Live P2P trial.

The Telco Sub-Group indicated that it would like to involve more P2P companies in further testing. The Cable Sub-Group discussed at a high level the current P4P trial results and cable-specific requirements for P4P.

The Research Sub-Group organized a meeting with the Internet Research Task Force (IRTF).

The Standards Sub-Group was working on a first-draft of the P4P specification. Intellectual property rights (IPR) policy formalization would be completed in advance of broader circulation of the draft spec. A preliminary document would be developed as well.

Many people participated in the IP Policy/Guidelines Sub-Group call. A draft purpose-and-scope document was circulated. The recommendation was made to incorporate the P4PWG in a way that would encompass an IPR policy for members, prior to advancing the P4P spec development process, and there was a discussion of alternative structures. A P4P frequently asked questions (FAQ) resource was in development along with an online resource of publicly available presentations.

In November, results of the second round of P4P field trials were released.

Major ISPs including AT&T, Comcast, and Verizon Communications participated in these field trials coordinated by Pando Networks and Yale University.

Comcast, participating in this second round, was the first cable operator to test P4P.

As part of this second round of P4P field trials, more than one million consumers worldwide downloaded a video program delivered by Pando Networks using different P2P algorithms including standard P2P delivery and P4P, a mechanism that allows ISPs to provide guidance to P2P applications.

The results demonstrated improved performance for all classes of users for all participating ISPs, using cable, digital-subscriber-line (DSL), and fiber-to-the-home (FTTH). Download delivery speed increased on average 59% – and up to 150% for the fastest class of users.

The second round of P4P field trials also showed improvements in how the P4P protocol can increase P2P efficiency for broadband network operators by delivering data to end-users from within their networks as opposed to pulling data from external sources. The percentage of data delivered within each ISP increased from 14% for normal P2P delivery to as much as 89% for P4P delivery.

In addition, a majority (up to 60%) of the internal data delivered using P4P was delivered within the same metro area. This decreases the distance data travels across an ISP network, thus increasing delivery speeds while decreasing overall network operating costs.

Pando Networks CTO and P4PWG co-chair Laird Popkin said, "This round of trials also introduced a new capability of P4P, extending the protocol to optimize traffic among ISPs. This allows ISPs, for example, to direct P2P applications to use private ISP-to-ISP connections instead of expensive transit across the general Internet, further improving delivery performance and reducing delivery cost."

Commenting on the release of the results, executives from industry-leading ISPs indicated support for the initiative and a willingness to participate in more testing.

"The trial results demonstrate that P4P has the potential to increase network efficiencies, which ultimately could provide Internet users with a better and faster broadband experience," said Charles Kalmanek, Vice President – Networking and Services Research, AT&T Labs. "We look forward to continuing our cooperative relationships with industry and academic partners, working together to find effective solutions for users and networks operators, and supporting their adoption."

"Comcast believes that collaboration and engagement with the Internet community, engineers, academics and other experts is the best way to evaluate new Internet technologies like P4P," said Barry Tishgart, VP of Internet Services for Comcast. "We're encouraged by the results of the first P4P trial recently conducted on our cable ISP infrastructure, and we look forward to participating in additional P4P trials as we continue to optimize our network to provide the best experience for all customers."

According to Verizon Senior Technologist Doug Pasko, co-chair of the P4PWG, "In this second round of P4P trials, route guidance reduced the P2P traffic entering Verizon's networks from a previous average reduction of 35% to a reduction of more than 75%. P2P traffic leaving Verizon's networks was reduced from an average of 41% to 54%. This again illustrates how ISPs can operate more efficiently if traffic remains on their own networks."

"The P4P field trials have repeatedly proven that localized P2P delivery is a 'win-win' for consumers, content owners and broadband network operators," added Robert Levitan, CEO of Pando Networks. "Pando Networks is proud to offer P4P functionality as a part of our content delivery cloud solution."

Plans for live P2P trials of P4P were moving ahead. The focus was to design a live streaming algorithm to utilize the P4P protocol. There was the need to better understand live streaming. The next meeting/call would be to determine how to implement the algorithm.

The Cable Sub-Group met and focused on Comcast's results from the second P4P field trial and cable-specific results. Among the results discussed, download performance improved by 82%. Current action items included working out random swarms vs. P4P swarms. More participants were sought for further tests which would examine larger swarms and larger download file(s).

For the Standards Sub-Group, a technology framework document was being developed with input being sought from P4PWG participants. It would continue to be developed for informal discussion at ALTO, followed by IETF submission.

The IP Policy / Guidelines Sub-Group prepared and distributed 2 documents for P4PWG participant review: the draft purpose and scope, and draft IPR policy. The final versions of these would be encompassed in the P4PWG incorporation documents.

A legal expert on incorporation matters discussed alternatives for the optimal type of legal structure to support the mission and objectives of the P4PWG. A non-profit association structure would provide the desired IP protection for members and facilitate the deployment of the final P4P specification(s). Participants could opt-in to become members. Management of a non-profit would be relatively simple, and implementation would be minimally disruptive. The board slate for initial one-year terms was discussed. Feedback was requested.

In December, the Live P2P Sub-Group reported that 6 ISPs and several developers were lined up for the live P4P test, which would also have a simultaneous Chinese component involving at least one major P2P company and ISP there, and the focus was now on defining the timeline for this trial. Consumers would get a proportional integral derivative (PID) that corresponds to their place in the network. The test would be similar to on-demand in many ways. Current channels would be divided between P4P and non-P4P to compare performance results.

The Caching Sub-Group said it would like to share results a caching vendor had obtained with several million users and verify these more broadly with additional broadband networks, as well as develop a more controlled P4P caching trial.

Productive discussions took place with IETF. In particular, a proposal from a major P2P firm had led to the recommendation of the production of a merged document. A unified proposal was generally viewed as preferable to competing ones. The P4PWG would be responsible for marketing, branding, etc. around the mutually agreed upon technical standard. (An analogy could be drawn with Wi-Fi, the marketing term for 80211, the wireless technical spec). 2 P4PWG representatives would lead in the production of a draft merged proposal with the input of others. Other P4PWG participants were encouraged to get involved. The P4PWG would continue development of the P4P specification through the process defined in the bylaws and IPR policy and provide it to the IETF to be incorporated in that process. The IETF would likely use a name other than P4P for its terminology.

The IP Policy/Guidelines Sub-Group finished its work with the completed IPR Policy now incorporated into the P4PWG bylaws.

Filing of the necessary documents for P4PWG's non-profit corporate status with Delaware and federal authorities was initiated. A draft P4PWG membership kit comprised of a brief membership agreement, articles of incorporation, bylaws, IPR policy, and technology framework document as a placeholder for the P4P specification had been circulated to core participants, who were asked to review it and submit questions and recommended changes.

2009 P4PWG Activities

In January, the P4PWG completed its structural formalization intended to pave the way for commercial deployment.

Doug Pasko, Senior Technologist at Verizon, and Laird Popkin, Chief Technology Officer (CTO) at Pando, who had served as co-chairs of the working group since its inception in July 2007, were elected as Co-Chairs of the BOD of the newly formed P4P Working Group, Ltd.

Pando Networks CTO and P4PWG Co-Chair Laird Popkin said, "The most recent round of P4P testing demonstrated substantial progress in improving content delivery performance and reducing costs. P4P adoption will be a winning proposition for consumers, content owners, and broadband network operators. The P4P Working Group's new status as a non-profit corporate alliance will allow us to implement an intellectual property rights (IPR) policy for members and move towards that goal."

Verizon Communications Senior Technologist Doug Pasko and P4PWG Co-Chair Doug Pasko added, "The second round of P4P trials again illustrated how ISPs can operate more efficiently if traffic remains on their own networks. The P4P Working Group's formal structuring will facilitate the completion of work on a final specification for P4P, which will represent its next major step towards commercial deployment."

Membership in the non-profit corporate alliance was open on a voluntary basis to current core participants in the working group and other qualified entities.

Live P4P field trial planning continued, although both US-based P2P companies and US-based ISPs began to express concerns about potential changes in the regulatory landscape under the new administration.

The Caching Sub-Group started working with parties that had expressed interest in participating, which included leading international P2P companies and suppliers. Discussion subject matter included discovery, traffic prioritization, commercial and non-commercial environments. Clarification was provided that participation in the sub-group represented a separate decision from participating in a prospective caching P4P field trial.

The Standards Sub-Group made progress in merging proposals, including those presented at ALTO with the goal of developing a unified proposal. The P4PWG would continue development of a draft specification and keep the IETF informed of progress. The technology framework document distributed in the fall would be the basis for the specification drafting process.

Based on subsequent download P4P field trials, details had been added; and more would be expected to be added based on the live P4P field trials, whenever and wherever they could take place. Drafting work would continue with the plan to incorporate specifics from the live tests as they were completed. Drafts would be circulated to P4PWG participants for review and comment.

Discussion clarified the scope of the P4PWG prospective specification and confirmed its openness to support multiple P2Ps (both live and download) and ISPs.

A related opportunity for industry advancement through interoperability and standardization of certain P2P application and protocol attributes was discussed, to be led by an offshore P2P services provider.

Converging architectures in a cooperative way, involving both protocols and clients, could make P2P utilization more attractive to institutional users. The drive for adoption of standards was a key goal of P2P Next in Europe. The idea of establishing a new interoperability sub-group with under the leadership of a UK-based leader was discussed.

A major ISP, after discussions with a leading P2P software firm, determined to commercially deploy P4P as tested in the final field trial. There was a de facto standard based on this testing that would be

implementable. The iTracker would be open for other P2Ps to use and interested parties should contact the ISP.

In February, the research team delivered binaries to the Live P2P Sub-Group. They were aiming to have all configurations finished within the next 2 weeks and then be able to commence the trials by the end of February if all participants were in concurrence and at least one domestic testing venue could be committed.

The Standards Sub-Group set up a status review call and considered adding an offshore resource to participate in specification authoring. There was a discussion of the process and number of participants (this would increase the number of authors on the document to 5). A participant advised that the IETF requires special authorization for more than 5 authors, but 5 are acceptable. It was noted that the drafting should stay focused on the P4P spec and not be expanded in an effort to merge technologies. A spec writer was recruited.

There was additional discussion of the possibility of creating another sub-group that would bring technologies together after the P4P spec had been completed. The approaches could be merged together into a single document; but first the P4P spec would be completed, and then that aspect could be addressed. The first priority would be to complete the P4P spec. There was consensus first to document what the P4PWG had done so far and second to work on a merged technology.

Issues associated with a proposed Interoperability Sub-Group were explored. The prospective leader noted that the P4PWG would need to agree upon a standard to be interoperable. It was deemed important also to map out what would be needed for branding and tactical testing. P4PWG participation was sought to help establish the basis from which to interoperate. A spec would be needed and reference implementation for interoperability testing. The research team had released a source code for the older version of P4P used in initial testing.

A new version of P4P was being worked on. A new iTracker would be released shortly. The library had just been released. A template would also be released with reference implementation of the iTracker. Another reference with open source was planned for release within a couple of weeks, pending work on the live testing plan, and this could be shared. The focus should be on what was actually being used and would be used going forward; other factors could be layered in later.

In March, the leading US live P2P streaming provider indicated that customer implementations, commercial service developments, and other considerations were taking precedence over its fielding the live P4P trial in the US.

The P4PWG began moving forward with a change in plans for its live trials to take place only overseas, and specifically in China.

The research team integrated the necessary data with the reference tracker and was hosting torrents. Live P2P and P2P streaming applications could now be integrated. Currently, integration of P4P with live streaming and upgrading to the most current versions of the P4P protocol were taking place concurrently. New topologies with global values were being added. Improvements were substantial: 6% for downloads and up to 9% for live streaming.

The Standards Sub-Group expressed gratitude to those who contributed to the draft P4P specification, which had now been distributed to all P4PWG participants and submitted to IETF's ALTO. This draft spec covered the work that had been done so far by the P4PWG.

An additional near-term project of the sub-group would be to merge this document with the one developed under an individual P2P company’s lead, depending on the P4PWG's overall standards strategy. The P4PWG standards strategy needed also to address the related prospective IETF third document and, longer-term, also merging the P4P protocol spec with that.

In addition, the P4PWG standards strategy should provide a blueprint for continually evolving the P4P spec based on improvements resulting from additional field trials and operating experience; where the core concept and architecture remain the same, but enhancements come from implementation detail.

As a next step, the Standards Sub-Group would evaluate the differences between the two current draft specification documents (similar information seemed to be being exchanged; differences were primarily in coding and some finer points) and redistribute the versions of these that had just been submitted to ALTO to all P4PWG core participants.

The formative Interoperability Sub-Group agreed that the suggestion of a reference client was a good one, and the next step needed to be based on a P4PWG-accepted draft P4P draft specification. Once that was set, the leader would like to recruit a few P4PWG members (ideally with some interoperability experience) to join this sub-group and chart a plan for the group. In the context of discussing how to handle a reference implementation, there was the recommendation to distribute patches and not a complete new code.

A leading cable ISP provided substantial assistance in revising the P4PWG formal membership documentation.

In April, the Standards Sub-Group gave a P4P presentation at the IETF meeting in San Francisco.

The Interoperability Sub-Group, noted that the current spec did not encompass caching and P4PWG leadership agreed that this needed to be added.

The membership structure and formalization process clarified the distinctions among observers (receive approved minutes), core participants (receive minutes, participate in meetings and activities, vote for and can serve on BOD), and members (receive minutes, participate in meetings and activities, vote for and can serve on BOD and other P4PWG matters, license P4P specification, and receive IPR protection).

There was a discussion of releasing P4P code so that P4PWG participants could explore the current version to identify and recommend further development opportunities. Additional discussion included two refinements of this proposal: 1) a possible stepped release process first to P4PWG participants only for two-to-three months and then expanding to include the IETF; and 2) whether to release only the public parts of the code or releasing all parts.

Discussion covered multiple concerns including the risks associated with open source (e.g., hackers trying to attack servers); standardization maintenance re: the IP application (e.g., releasing the application library which wouldn’t be part of any standard); and exogenous factors, including unknown regulatory factors.

The leading ISP participant in China expanded its deployment trials with three leading Chinese P2P applications. The first web test would take place in May in one province in China. The ISP intended to expand this to cover the majority of public P2P traffic by July and by October to reach all geographic regions of China where it offered service.

There were complex issues associated with this re: IPR, particularly. The Chinese ISP was asking for a "P4P lite," a simpler version to use for smaller, less technically sophisticated P2P applications.

The carrier was also asking for the capability to measure compliance, to be able to detect whether P2P applications were indeed taking advantage of the P4P data provided by the ISP.

In May, a Streaming Media East P2P panel featured executives representing US-based P4PWG participants Abacast, Comcast, Velocix, and Verizon. For the first time, P2P was an agreed upon objective. The audience was receptive.

An individual Internet draft had been submitted into the IETF, with the approval to publish as a sponsor.

An implementation of the P4P library was available at this point with a tutorial.

In June, 3 algorithms were finished for live P2P and a link to the library was circulated. The live code would be ready in a few more weeks.

IETF collaboration continued to remain a priority at this time. Standards were making good progress. There had been quite a few meetings in the last few weeks. The next step would be a larger group meeting that would include leading ISPs from China.

Agreement on standards would go along the lines of previously communicated transport and coding formats. Additional standards documentation should be ready by July to go out to the P4PWG and then to others for feedback.

In July, the Live P2P Sub-Group indicated that live-trial development would resume in approximately 2 months, based on the timing for ongoing standards-development activities. The required algorithms should be stable by then.

Caching proposal considerations included transparent vs. non-transparent caches and open vs. non-open protocols. Applying P4P to the cache would pose several challenges. The next step here would be to develop an acceptable design and then a way to test it. This would take some time to evolve.

The draft proposal for ALTO was completed and feedback from P4PWG participants was solicited. In this proposal, the protocol had been divided into four types and includes such topics as endpoint properties of P2P and mobile, etc.; endpoint property maps: location, aggregation; path property queries; specifying endpoints as locations; path-reading properties.

Everyone involved had agreed upon the framework, which was simple and sensible. The coding was clean. The P4PWG wanted to ensure that international software providers and ISPs that desired to were able to use the protocol. There was now a P4P public library that could cross-promote to encourage use.

In terms of comparing the ALTO proposal to previous P4P testing terminology, the ALTO server and iTracker were similar; the ALTO client and pTracker were similar (with the distinction of the PID). 2 P4PWG participants would attend IETF.

A suggestion from testing participants in China was made to explore developing a P4P compliance program. The idea of sampling to test for compliance was briefly discussed. This would need to be detailed enough to determine whether applications were using the provided information optimally and what the impact was to the network in terms of efficiency improvement. Possible methods were discussed as was the issue of the amount of information involved. A recommendation was made to consider creating a new sub-group to further develop compliance monitoring.

There was no August meeting. In September, the Live P2P Sub-Group reported that it had been conducting high-level planning for the live P2P streaming trial of P4P. The relevant algorithms were stable and were being tweaked for further enhancement. It was determined that the focus of this trial would be on one or more P2P services and ISPs in China, which were in the best position to move ahead without complications due to exogenous factors.

The Caching Sub-Group was recommended to be the priority for field tests once the live trials had been completed. Related to this, IETF indicated that it was starting a working group focused on caching, with preliminary information to be discussed at IETF's Hiroshima meeting in November.

A successful meeting took place in with the IETF in Stockholm on standards setting. Work was progressing well with the hope that a working draft would be ready for the Hiroshima meeting.

On the topic of compliance monitoring, there was some interest among ISPs, but there were numerous issues to overcome in order to provide for this, including regulatory concerns. 2 aspects of this were: 1) benchmarking baseline operating performance; and 2) measurement of net benefits achieved.

What would be the proper ways to measure this? In terms of comparison, the baseline was important to have as a starting point. It must be tracked to some extent back through the system. An ISP participant outlined the concept for a possible standard model that ISPs could generate for participating software providers to use to determine and verify the efficiency of their traffic behavior on their network. It would be important to ensure that participants got back usable data from this to make any needed improvements.

In October, a new P4P website was opened for P4PWG members and core participants featuring assembled P4P documentation at this address: http://p4p.cs.yale.edu.

The website contained the following direct information and/or links to this information:

1. An overview of the P4P framework and the goals of the P4P protocol.

2. P4P integration library for P4P app developers.

3. ISP integration guide for ISPs wishing to learn about or build a portal server.

4. Links to the IETF internet draft and the SIGCOMM 2008 paper on P4P.

5. Links to download pre-built packages and to the actual source code for the integration of library and portal server components.

The Live P2P Sub-Group indicated that there was still interest in companies in other locations that wanted to participate in live trials to complement the work going on in China.

Initial data had been collected and some analysis completed, while researchers were still in the process of perfecting the algorithms. A link to a public channel, a medium sized one, with algorithms re: locations could be made available. The network was partitioned into 32 PIDs (regions). There were a fixed number of peers in each PID. Attempts were to match supply vs. demand, peer selection, and further testing. New algorithms would make sure there was enough supply and then utilize the extra for robustness. They continued to revise and encode. 3 trackers were running at the moment.

The Caching Sub-Group was identified to be the priority for field tests once the live trials had been completed.

An international ISP reported that it was in the process of doing studies and talking one-on-one with P2P companies.

There was a live streaming algorithm to improve live streaming performance. A new paper was published, with some IP info re: the peers-only which produced interesting results.

The P4PWG in coordination with the IETF was looking at the big picture that would provide a complete framework for an architecture and how it would be designed at network and how it would make use of network storage. The paper describing this would be shared with the entire group.

On the topic of compliance monitoring, there was still the question of how the ISPs and the P2Ps could check with each other. So far, no final solution had been proposed, and the P4PWG was still looking for good ideas.

The new P4P website was password-protected for members and core participants only. It would be opened next to observers for feedback, and then to the public.

In November, it was noted that there had been a pick-up in media inquiries in conjunction with the IETF standards-setting process and increased visibility of the network neutrality debate as a result of FCC activity. Calls from the press recently increased. A leading technology blogger expressed interest in following the progress of the group and would be posting additional reports going forward.

Live P2P Sub-Group test results were in the process of being gathered from the live testing underway in China. Recently there had been a change in the key participating P2P service's business strategy that would impact the time to complete this phase. Previously, the testing focused on a channel that was made available automatically when users upgraded to a new version of the software. With new senior management coming into the company in October, this changed and therefore the testing environment became heterogeneous.

The research team responded by designing a new common object model so that everyone would have the same model for logging results. The P2P service would push the log object to every client and then researchers would be able to collect the logs. Initial results had been favorable, but the sampling was still too small to comprise a statistically valid report upon which test data could be released.

Changes were also underway to a new and improved P4P architecture and the P4P library was being changed to a new format.

A new approach to do caching within networks was also being explored. The P4PWG began to explore assembling a design team with participating company representatives to work with researchers on this effort. The architecture being proposed would have many benefits including mobility, storage, etc. The productivity of this work could advance with commercial company involvement on the design team, specifically with expertise in network storage, caching, etc.

The Cable Sub-Group focus was on the IETF meeting in Japan, where considerable progress was made in the area of standards setting. The ALTO session went very well. A draft was approved for the group document by attendees and is now being sent to all members on the list. Adoption as a working group document means that ALTO believes this is the way to go. The major architectural elements were there. Timing for the next step was the IETF meeting in March, at which we would see how many details could be worked out. P4P was being incorporated as part of a larger more encompassing ALTO protocol.

In accordance with P4PWG bylaws, the 2010 BOD election would take place at the next monthly meeting. The slate of candidates would be published to P4PWG participants no later than December 1st.

In December, the P4PWG elected its 2010 BOD: Richard Alimi, Yale University; Rick Buonincontri, Solid State Networks; Eric Klinker, BitTorrent; Marty Lafferty, DCIA; Robert Levitan, Pando Networks; Doug Pasko, Verizon Communications; Mark Peterson, Alcatel-Lucent; Emilio Sepulveda, Telefonica; Barry Tishgart, Comcast; Steven Wright, AT&T; and Richard Yang, Yale University.

The Live P2P Sub-Group indicated that trackers at a leading P2P service in China were now running 5 algorithms and collecting data. However, additional data needed to be gathered to complete a statistically valid report.

Meanwhile, this P2P company was making changes in order to stabilize logging; and agreed to provide its proposed log format to the P4PWG. One of the benefits of a common log format would be to make it easier to analyze test data. It was estimated that it would take approximately 2 weeks for the company to update all its clients.

In addition, the research team was evaluating a change to a common version of the library and forecast that results could be available within month or so.

The Caching Sub-Group asked for further discussion on what types of controls applications should have over network storage. Planning had progressed for a test of P4P and caching with a major ISP also in China.

An international ISP underscored the importance for network operators when supporting caching that data access should be available from P2P applications and offered to collaborate with P4PWG researchers.

Meanwhile, another large P2P application in China, which supports 3 protocols, voiced support for offline storage.

The Standards Sub-Group reported that it was resubmitting its paper to ALTO with edits to conform to IETF requirements and that the P4PWG would also have a corresponding version that would support earlier implementation.

A major remaining challenge of large-scale P2P live streaming systems was identified as: how to handle flash crowds (i.e., the arrival of a large number of peers in a short time period). Multiple factors make flash crowds challenging to handle. One is substantial peer churn.

Another is substantial delay in the convergence process. Entering 2010, the P4PWG will explore the development of guidelines to construct effective initial topologies to lead to fast and robust convergence. In particular, it intends to investigate how network information can improve the process. The P4PWG Research Sub-Group is looking for research collaboration on this subject.

In addition, the building of topologies and design coordination mechanisms for a set of nodes inside a campus/enterprise network was identified as another topic that the P4PWG Research Sub-Group would like to work on. There are multiple issues that need to be addressed. One issue is the discovery of coordinating sets. The second is the coordination mechanisms among each set of nodes. Best practices can potentially benefit not only each particular application but also coordination of multiple P2P applications sharing the same bottlenecks.

Conclusion

The Distributed Computing Industry Association (www.DCIA.info), a non-profit trade organization focused on commercial development of peer-to-peer (P2P) technologies and related distributed computing applications, has sponsored and facilitated the P4P Working Group (P4PWG) since July 2007.

P4P is defined as a set of business practices and integrated network topology awareness models designed to optimize Internet service provider (ISP) network resources and enable P2P based content payload acceleration.

DCIA Member companies are engaged in developing and deploying competitive commercial services that use P2P and related technologies, including cloud computing, downloadable file sharing, live P2P streaming, swarming, caching, torrenting, content acceleration, peer-to-peer television (P2PTV), and hybrid P2P content delivery network (CDN) offerings, among others.

DCIA Member companies are also engaged in creating, aggregating, and delivering content, representing music, video, games, and software categories.

And finally, DCIA Member companies are engaged in providing and supporting Internet access services, including the most rapidly expanding and highest value area within the telecommunications sector, broadband or high-speed offerings.

DCIA Member companies and other competitive distributed computing applications and services represent the technologically most advanced and fastest growing segment for delivery of digital content over the Internet.

The DCIA strongly supports the Federal Communications Commission's (FCC's) principles that emphasize the importance of an open Internet as a vehicle for empowering consumers, putting users at the forefront of deliberations as to whether broadband networks are operating appropriately, without discriminating against institutional users of network resources; and whether such applications and services, as well as content providers themselves are operating appropriately, without abusing these network resources.

Our concern is that the uncertainty associated with the Commission's current rulemaking process has caused US-based industry participants to curtail their participation in the P4PWG, an important and effective process, which had been addressing key areas of broadband network resource utilization and related P2P software functionality, and to reduce their involvement to a wait-and-see status until this can be clarified.

P4P has been successfully field-tested by AT&T, Comcast, and Verizon Communications, for example, working with Pando Networks and Yale University; and key results of these trials have been published.

As is clearly illustrated by the contrast in the 2007-through-2008 versus the 2009 track record of accomplishments of the P4PWG, which was very active with US-based field trials, sub-group expansion, standards-setting activities, and related steps demonstrating substantial progress during the former period, these efforts have essentially moved offshore during the latter period.

The FCC has an important role to play in ensuring that the Internet continues to develop to its fullest potential as an open, competitive environment for innovative services that will benefit consumers.

The intention of establishing the P4PWG was to formulate an approach to P2P network traffic management as a joint optimization problem. The objective of certain participating ISPs, for example, was to minimize network resource utilization by P2P services. The objective of certain participating P2P software firms, conversely, was to maximize throughput. The joint objective of both ISPs and P2P software developers was to protect and improve their customers' experience.

2007 marked a turning point for the emerging P2P industry, with P2P beginning to become part of the content delivery infrastructure in large scale deployments, and content owners increasingly indicating a preference for integrated P2P and CDN solutions. Major content and CDN players started to select P2P technology partners to enhance their service offerings.

Meanwhile, Internet traffic between the years of 2000 and 2007 saw P2P grow from virtually non-existent to representing as much as 50-65% of downstream traffic and 70-80% of upstream traffic in many locales.

At its highest level, the P4PWG represents the opportunity for partnerships among ISPs and P2P networks to address this. There are currently more than 50 active participating companies in the P4PWG representing ISPs, P2P software distributors, researchers, and service-and-support companies. In addition, there are now approximately 50 observers, representing vendors, cable multiple system operators (MSOs), content providers, and other interested parties.

P4P can provide the way to solve a pending bandwidth crisis before it becomes a serious threat and provide a means to collaboratively and cooperatively address future capacity concerns. There is the potential to have carrier-grade P2P with P4P, which in turn can open opportunities for innovative new services, once it has been established that the fastest path from point A to point B on a network is via P4P-enhanced P2P. Benefits to consumers will include faster downloads, higher quality of service (QoS), and potential assurances of not being subject to service interruptions or degradation.

In short, P4P can enable content delivery that is more efficient for both the consumer and the network operator compared to alternative architectures. To that end, the DCIA recommends that the Commission encourage network operators, Internet companies, content rights holders, consumer groups, and other interested parties to discuss a variety of reasonable network management practices using private sector forums such as the P4PWG as well as public platforms.

It would not be inappropriate for ISPs to receive appropriate compensation from content providers using P2P for the services and delivery enhancements that ISPs may offer to them through capabilities like P4P. Alternate, flexible financial arrangements may assist ISPs by providing the appropriate financial incentives to add significant capacity for such services in better alignment with traffic demands.

The DCIA recognizes that, given the inherent dynamism and rapid growth of the Internet, flexibility is a critical component of network management. Therefore, the Commission should avoid adopting strict network management rules that could preclude new opportunities for collaboration and new business models between ISPs and application providers that would help to improve the experience of end-users accessing the applications and content of their choice over the Internet.

In light of the rapid growth in this area, the scope of its impact on important consumer services and the commercial value of the offerings thereby represented, and the potential impact of this area of activity on other vital Internet services, the FCC should seek to provide consumers, ISPs, and applications, services, and content providers with clarity regarding what to expect with respect to broadband network management practices.

Uncertainty associated with the Commission's current rulemaking process in this area has caused US-based industry participants to temporarily reduce their active involvement is an important and effective process, which had been addressing key areas of broadband network resource utilization and related P2P software functionality under the auspices of a voluntary private sector initiative, and to slow the pace of progress.

The accomplishments of US firms contributing to the P4PWG from 2007 through 2008 far exceeded their successes in 2009. US-based field trials, sub-group expansion, standards-setting, and related activities demonstrating genuine productivity have essentially moved offshore.

We respectfully request that the FCC act to provide the needed certainty and offer the required clarity.